

REMARKS

Request for an Examiner's Interview

The Applicants and the Applicant's attorney hereby request a telephone interview with the Examiner in order to expedite the prosecution of the present patent application.

Pending Claims

Claims 1-5, 7-9, 11-21, 23-31, and 33-42 are pending in the present application. Claims 6, 10, 22, and 32 have been canceled. Claims 1, 5, 8-9, 11-13, 17-21, 24-26, 31, 33-35, and 40-42 have been amended. The Applicants respectfully request reconsideration of the pending claims in light of the amendments and arguments presented in this Amendment and Response.

Rejections under 35 U.S.C. §102

Claims 1-3, 8, 14, and 19 are rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent No. 5,745,613 to Fukuchi et al. (hereinafter "Fukuchi"). According to the Office Action, Fukuchi describes an optical transmitter that includes an optical intensity modulator where at least one parameter (the α parameter) of the intensity modulator is chosen to suppress at least one of phase and sideband information in the modulated optical signal. The Office Action refers to Fukuchi column 4, lines 23-30, column 5, lines 18-22, and column 4, lines 28-36 to support the argument that Fukuchi describes an optical intensity modulator where a parameter is chosen to suppress at least one of phase and sideband information in the modulated optical signal.

Fukuchi describes the α parameter as a metric that defines the chirp magnitude.

Fukuchi describes Chirp as the component of the phase change of the light. Specifically,

Fukuchi defines the α parameter as

$$\alpha = \frac{d\phi}{2IdI},$$

where $d\phi$ is the variation of the phase of the light, I is the intensity of the light, and dI is the variation of the intensity of the light. The Applicants believe that the term “ $dI\phi$ ” in Fukuchi column 4, line 34 should instead be “ dI .”

The text cited in the Office Action refers to what Fukuchi describes as the first embodiment of his wavelength division multiplexing optical communication apparatus. The optical modulator comprises a Mach-Zehnder type interferometric (MZI) modulator. See column 6, lines 27-44. In a MZI modulator, the intensity and phase of the modulated optical signal can be independently adjusted. The phase of the modulated optical signal is changed by directly tuning the bias voltage, which changes the electro-optic coefficients.

Fukuchi also describes using an EAM in what Fukuchi describes as the second embodiment of his wavelength division multiplexing optical communication apparatus. Fukuchi teaches that a semiconductor EAM has an α parameter that varies as the center of the operating point or bias point of the driving waveform is changed. See Fukuchi column 8, lines 48-53 and FIG. 8. Fukuchi states that when the value of the α parameter is controlled by the operating point in the EAM there is difficulty in achieving the effects and advantages of his invention when compared to the first embodiment using the MZI. See Fukuchi column 9, lines 20-25.

Thus, Fukuchi teaches changing the phase of a signal modulated with a MZI by changing the intensity. Also, Fukuchi teaches changing the phase of a signal modulated by an EAM by changing the bias. Fukuchi does not mention changing intensity, bias, or any other parameter to suppress sideband information in the modulated optical signal as claimed in the amended claims of the present application.

The claims of the present application have been amended to more clearly define the invention. In particular, the apparatus claims have been amended to recite an electro-absorption modulator (EAM). Also, the apparatus claims have been amended to recite that an absorption spectrum of the electro-absorption modulator is chosen to suppress both phase and sideband information in the modulated optical signal.

Electro-absorption modulators are fundamentally different from the MZI modulators described in connection with Fukuchi's first embodiment and the text cited in the Office Action. Semiconductor electro-absorption modulators absorb input light in accordance with the applied voltage according to the Frantz-Keldish effect as described by Fukuchi. Fukuchi states that the range in which the α parameter of an EAM can be varied is narrow. Furthermore, Fukuchi states that since the transmission wavelength is changed as the bias point is changed, the transmission quality may be deteriorated. See Fukuchi column 9, lines 8-19.

The Applicants have discovered that the phase change imparted by an EAM is more effectively tuned or suppressed by properly choosing the absorption spectrum of the EAM during design and fabrication. According to the Kramer-Kronig relations, which are well known in the art, the magnitude of the phase change of signals generated by an EAM

depends on how far the operating wavelength is from the absorption edge of the EAM material.

To anticipate a claim under 35 U.S.C. §102, a single reference must teach every aspect of the claimed invention either explicitly or impliedly. Any feature not directly taught by the reference must be inherently present in the reference. Thus, a claim is anticipated by a reference only if each and every element of the claim is described, either expressly or inherently, in a single prior art reference.

As described above, independent claim 1 has been amended to recite an optical transmitter including an EAM where the absorption spectrum of the EAM is chosen to suppress phase and sideband information in the modulated optical signal. The Applicants submit that Fukuchi does not describe an optical transmitter that uses such an EAM. Instead, Fukuchi describes a method of changing the phase of a signal modulated by an EAM by changing the bias operating point. Fukuchi characterizes this method of changing the phase of a signal modulated by an EAM by changing the bias as being difficult to achieve the effects and advantages of his invention compared with methods using a MZI. In addition, the Applicants submit that Fukuchi does not describe changing the α parameter or any other parameters to suppress both the phase and sideband information in the modulated optical signal as claimed by independent claim 1.

Therefore, the Applicants submit that independent claim 1 is allowable over Fukuchi. In addition, the Applicants submit that dependent claims 2-5, 7-9, and 11-19 are allowable as depending from an allowable base claims.

Rejections under 35 U.S.C. §103(a)

Claims 20, 23-24, 27, 29, and 31 have been rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent 6,064,786 to Cunningham (hereinafter “Cunningham”) in view of Fukuchi. Also, claims 15-16, 35-38, and 42 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Fukuchi in view of Cunningham.

To be unpatentable under 35 U.S.C. §103(a), the differences between the subject matter sought to be patented and the prior art must be such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art. There must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify or combine the reference teachings.

To establish a prima facie case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of the ordinary skill in the art, to modify the references or to combine the reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not on Applicant’s disclosure.

According to the Office Action, Cunningham teaches a spatial mode filter having an input that is coupled to an output of the signal mode optical fiber and an output that is coupled to an input of a multi-mode optical fiber. The Office Action concludes with regard to independent

claim 20 that it would have been obvious to one of ordinary skill in the art to modify the system of Cunningham by using the optical intensity modulator taught by Fukuchi to improve transmission characteristics. In addition, the Office Action concludes with regard to independent claims 35 and 42 that it would have been obvious to one of ordinary skill in the art to employ spatial mode filtering as taught by Cunningham into the system described by Fukuchi to reduce modal dispersion of the multi-mode optical fiber and to increase the transmission bandwidth.

Independent claim 20 has been amended to recite a multi-mode optical transmission system including an EAM where the absorption spectrum of the EAM is chosen to suppress phase and sideband information in the modulated optical signal. The Applicants submit that Fukuchi and Cunningham together do not teach or suggest a transmission system that includes such an EAM. Instead, Fukuchi teaches changing the phase of a signal modulated by an EAM by changing the bias, which Fukuchi describes being difficult to achieve the effects and advantages of his invention. Furthermore, the Applicants submit that Fukuchi does not describe changing the α parameter or any other parameters to suppress both the sideband information in the modulated optical signal.

Therefore, the Applicants submit that independent claim 20 is allowable over Fukuchi and Cunningham. In addition, the Applicants submit that dependent claims 21, 23-31, and 33-34 are allowable as depending from an allowable base claims.

Independent claim 35 has been amended to recite a step of intensity modulation that suppresses both phase and sideband information in the modulated optical signal. The Applicants submit that for the reasons described herein such a step of intensity modulation is not taught by Fukuchi and Cunningham. Therefore, the Applicants submit that independent claim 35 is

allowable over Fukuchi and Cunningham. In addition, the Applicants submit that dependent claims 36-41 are allowable as depending from an allowable base claims.

Independent claim 42 has been amended to recite a means for intensity modulating an optical signal, wherein the intensity modulation suppresses both phase and sideband information in the modulated optical signal. It should be understood that independent claim 42 is drafted in means plus function language under 35 U.S.C. §112 paragraph 6, which requires that the limitations be interpreted in light of the structure disclosed in the specification. Thus, the Applicants submit that for the reasons described herein, such a means for intensity modulating is not taught by Fukuchi and Cunningham. Therefore, the Applicants submit that independent claim 42 is allowable.

CONCLUSION

Claims 1-5, 7-9, 11-21, 23-31, and 33-42 are pending in the present application. Claims 1, 5, 8-9, 11-13, 17-21, 24-26, 31, 33-35, and 40-42 have been amended. The Applicants respectfully request reconsideration of the pending claims in light of the amendments and arguments presented in this Amendment and Response.

If, in the Examiner's opinion, a telephonic interview would expedite prosecution of the present application, the undersigned attorney would welcome the opportunity to discuss any outstanding issues, and to work with the Examiner toward placing the application in condition for allowance.

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